U.S. ATOMIC ENERGY COMMISSION

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

REGULATORY GUIDE 3.8

PREPARATION OF ENVIRONMENTAL REPORTS FOR URANIUM MILLS

APRIL 1973

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INTRODUCTION

NATIONAL ENVIRONMENTAL GOALS

Prior to the issuance of a license authorizing uranium milling activities, the U.S. Atomic Energy Commission is required to assess the potential environmental effects of the proposed activities in order to assure that issuance of the license will be consistent with the national environmental goals as set forth by the National Environmental Policy Act of 1969 (Public Law 91-190). In order to obtain information essential to this assessment, the Commission requires each applicant for a license to submit a report on the potential environmental impact of the proposed mill and related activities.

The national environmental goals as expressed by the National Environmental Policy Act (NEPA) are as follows:

"... it is the continuing responsibility of the Federal Government to use all practical means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may

"(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

"(2) assure for all Americans safe, healthful, productive and esthetically and culturally pleasing surroundings;

"(3) attain the widest range of beneficial use of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

"(4) preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

"(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

"(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

APPLICANT'S ENVIRONMENTAL REPORTS

Appendix D, entitled "Interim Statement of General Policy and Procedure: Implementation of the National Environmental Policy Act of 1969 (Public Law 91-190)," of the Commission's regulation 10 CFR Part 50, specifies in paragraphs A.1 and 14, that each applicant for a license authorizing uranium milling submit with his license application two hundred copies of a separate document entitled "Applicant's Environmental Report - Construction Permit Stage," which discusses the following environmental considerations:

"(a) the environmental impact of the proposed action,

"(b) any adverse environmental effects which cannot be avoided should the proposal be implemented,

"(c) alternatives to the proposed action,

"(d) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

"(e) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."

The discussion of alternatives to the proposed action in the Environmental Report must be sufficiently complete to aid the Commission in developing and exploring, pursuant to section 102(2)(D) of the National Environmental Policy Act, "appropriate alternatives ... in any proposal which involves unresolved conflicts concerning alternative uses of available resources."

The Environmental Report must also include a cost-benefit analysis which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental, economic, technical, and other benefits of the facility. The cost-benefit analysis shall, to the fullest extent practicable, quantify the various factors considered. To the extent that such factors cannot be quantified, they shall be discussed in qualitative terms. The Environmental Report should contain sufficient data to aid the Commission in its development of an independent cost-benefit analysis covering the factors specified.

The Environmental Report must further include a discussion of the status of compliance of the facility with applicable environmental quality standards and requirements which have been imposed by Federal, State, and regional agencies having responsibility for environmental protection. In addition, the environmental impact of the facility shall be fully discussed with respect to matters covered by such standards and requirements irrespective of whether a certification from the appropriate authority has been obtained (including, but not limited to, any permit or certification obtained pursuant to section 401 of the Federal Water Pollution Control Act, as amended). Such discussion shall be reflected in the cost-benefit analysis section of this report. While compliance with AEC standards and criteria pertaining to radiological effects will be necessary to meet the licensing requirements of the Atomic Energy Act, the cost-benefit analysis shall, for the purposes of the National Environmental Policy Act, consider the radiological effects together with other environmental effects of the facility.

PREPARATION OF ENVIRONMENTAL REPORTS

Appendix D of 10 CFR Part 50 provides general information concerning the content of an applicant's Environmental Report. To provide specific and detailed guidance, the following "Standard Format and Content of Environmental Reports for Uranium Mills" has been prepared.

If any topics in this guide relate to information not available at the time the environmental report is prepared, the applicant should indicate when the information will be available. If any topics are not relevant to the particular mill under consideration, the applicant should identify them.

Descriptive and/or narrative text as well as tables, charts, graphs, etc. should be used in the Report. Each subject should be treated in sufficient depth to permit the Commission to evaluate independently the extent of the environmental impact. In cases where test results are needed to support conclusions, test data, procedures, techniques, and equipment used to perform tests should be included. Tables, line drawings, and photographs should be used wherever contributory to the clarity of the Report. Descriptive and narrative passages should be brief and concise.

Pertinent published information relating to the site, the mill, and its surroundings should be referenced. Where published information or assumptions are essential to evaluate specific environmental effects of the proposed activities, they should be included in summary or verbatim form in the Environmental Report or as an appendix to the report.

Some of the information to be included in the Environmental Report may have already been prepared by the applicant during preparation of the license application for the proposed mill. In such cases, this information (whether in the form of text, tables, or figures) should be incorporated in the Environmental Report where appropriate in order to provide a complete document.

The site for the mill may also be the site of the mine. The applicant, in preparing the Environmental Report relating to such a mill, should consider the cumulative or synergistic effects of mining activities.

STANDARD FORMAT AND CONTENT OF ENVIRONMENTAL REPORTS FOR URANIUM MILLS

1.0 PROPOSED ACTIVITIES

This section should discuss the proposed project to be conducted at the site. For example, such matters as ore reserves, anticipated quantity of ore to be mined and milled, mining method, plans for overburden disposal, milling process, plans for tailings control, operating plans and schedules, expected longevity of the project, U_3O_8 content of the ore, concentrate yield, and end use of the product should be discussed.

2.0 THE SITE

This section should present the basic, relevant information concerning those physical, biological, and human characteristics of the area environment that might be affected by the construction and operation of a mine and mill on the designated site. To the extent possible, the information presented should reflect observations and measurements made over a period of years.

2.1 Site Location and Layout

Provide a map showing the site and its location with respect to State, county and other political subdivisions. On detailed maps show location of the plant perimeter; exclusion area boundary; applicant's property; abutting and adjacent properties, including water bodies, wooded areas, and farms; nearby settlements; industrial plants, parks, and other public facilities; and transportation links (railroads, highways, waterways). Indicate total acreage owned by the applicant and that part occupied or modified by the mine and mill. Indicate other existing and proposed uses of applicant's property and the acreage devoted to these uses. Describe any plans for site modifications, such as a visitors' center, etc. A contour map of the site should also be supplied.

2.2 Regional Demography and Land Uses

Two maps indicating nearby inhabited locations and the locations and areas of towns and cities should be provided. One map should cover an area showing all inhabited locations which might reasonably be affected by the proposed activities. The permanent and transient populations within these areas should be tabulated for the last year in which affected populations were not influenced by the proposed activities plus census years through the anticipated life of the project. The other more detailed map should include the same information for an area whose boundary represents those points where individuals, if present, might be exposed to radioactive materials in excess of one percent of natural background.

Descriptive material should include tables giving significant population and visitor statistics of neighboring schools, plants, hospitals, sports facilities, residential areas, parks, etc., within 5 miles of the plant. Indicate the nature and extent of present land use (agriculture, livestock raising, dairies, residences, industries, recreation, transportation, etc.).

Note whether any other nuclear fuel cycle facilities are located within a 50-mile radius of the site.

The degree of detail to be provided will generally depend on the distance from the plant. Nearby activities (generally within 5 miles of the plant) should be described in greater detail than those at greater distances.

2.3 Regional Historic, Scenic, Cultural, and Natural Landmarks

Areas valued for either their historic, scenic, cultural, or natural significance may be affected. The Environmental Report should include a brief discussion of the historic, scenic, cultural, and natural significance, if any, of the site and nearby areas with specific attention to the sites and areas listed in the *National Register of Historic Places* and the *National Registry of Natural Landmarks*. The 1972 cumulative revision of the *National Register of Historic Places*" is in the *Federal Register* of March 15, 1972, 37 F.R. 5428; additions are published in the *Federal Register* on the first Tuesday of each month. The *National Registry of Natural Landmarks* appears in the *Federal Register* of January 29, 1972. Also, the applicant should discuss its consultation with the appropriate State Liaison Officer for Historic Preservation concerning properties under consideration for nomination to the *National Register of Historic Places*. The Environmental Report should contain evidence of contact with the Historic Preservation Officer for the state involved and a copy of his comments concerning the effect of the undertaking on historic, archaeological, and cultural resources. State Liaison Officers are listed in the *Federal Register* of March 15, 1972 and supplemented in December 1972. In addition, indicate whether or not the site has any archaeological significance and explain how conclusions were reached. If such significance or value is present, describe plans to ensure its preservation.

State whether new roads, pipelines, and utilities connected with the proposed project will pass through or near any area or location of known historic, scenic, cultural, natural, or archaeological significance.

2.4 Geology

Describe the major geological aspects of the site and its environs. The discussion should note the stratigraphy, structure, and tectonic history. Comment on regional continuity, faulting, dip, and strikes of water-bearing formations that will be affected. An inventory of economically important minerals, in addition to the uranium ore, should be included when mining operations are planned. Any effect that planned operations might have on the future availability of other mineral resources should be noted.

Detailed geological data at building sites and in the vicinity of tailings ponds or other effluent impoundments, sanitary landfills, and sewage disposal facilities should be included. These data should include strike and dip and lateral and vertical distribution of permeable layers, shales, and clays, and data on any fault, fracture, or joint pattern which may exist. Locations of local outcrops where seepage from landfills, impoundments, and sewage facilities is likely to occur should be noted.

The location of groundwater with respect to tailings ponds, liquid impoundments, sanitary landfills, and sewage disposal facilities is important for the assessment of possible groundwater contamination. The discussion should include a statement concerning the hydraulic properties (permeability and porosity) of the materials between the groundwater and the above facilities.

2.5 Seismology

Discuss the seismicity (including history) of the region. Where possible, associate seismic events with tectonic features identified in the geology discussion. Furnish a regional earthquake epicenter map showing site location.

2.6 Hydrology

The effects of plant construction and operation on ground and surface water sources are of prime importance. The information indicated in the following sections should be presented in sufficient detail to allow an independent review to be made of the effects of construction and operation on both resources.

2.6.1 Groundwater

Describe the hydrology of the region that affects the local groundwater aquifers, formations, sources, and sinks. Describe the recharge potential of the immediate plant area, including vertical and horizontal permeabilities of the natural and modified terrain, as well as that of tailing areas. Describe the present and projected regional use; tabulate existing private users within the area influenced by the proposed activities and all local and regional public users (amounts, water levels, locations, and drawdown); indicate gradients and seasonal variations in groundwater levels beneath the site.

2.6.2 Surface Water

Describe the location, size, shape, and other hydrologic characteristics of water bodies in the environs of the site.

Include a description of upstream and downstream river control structures and downstream water supply users (including location, amount, and purpose, i.e., domestic, agricultural, etc.), and provide a topographic map showing the major hydrologic features. Assuming failure of any site dams or solid process waste piles under severe flood-producing conditions, analyze and describe any injurious effects to downstream residents from flood waters or contaminants in the waste. Where

potential for harm exists from such assumed failure, the applicant should describe the flood, foundation, and seismic criteria used in the design of such facilities and discuss their ability to safely pass or retain a probable maximum flood (PMF), as defined by the Corps of Engineers.

2.7 Meteorology

Present the following data on site meteorology: (1) diurnal and monthly averages and extremes of temperature and humidity; (2) monthly wind characteristics (including speeds, directions, frequencies and joint wind speed, stability category, wind direction frequencies; (3) data on precipitation; (4) frequency of occurrence and effects of storms.

(In the second item, the joint wind speed-stability-direction frequencies should be presented in tabular form, giving the frequencies as fractions when using 5-year National Weather Service summaries or as number of occurrences when using only one or two years of onsite data. The data should be presented for each of the 16 cardinal compass directions, and the stability categories should be established to conform as closely as possible with those of Pasquill.)

2.8 Ecology

In this section the applicant should identify the important flora and fauna in the region of the site (which may reasonably be expected to be affected by the proposed activities), their habitats and distribution, as well as the relationship between species and their environments. A species, whether animal or plant, is "important" (1) if it is commercially or recreationally valuable, (2) if it is rare or endangered, (3) if it affects the well-being of some important species within criteria (1) and (2) above, or (4) if it is critical to the structure and function of the ecological system. A "rare or endangered" species is any species officially designated as such by the U.S. Fish and Wildlife Service.

In cataloging the local organisms, the applicant should identify and discuss the abundance of the important terrestrial vertebrates and aquatic organisms. The discussion should include species that migrate through the area or use it for breeding grounds. The applicant should provide data on the count and distribution of important domestic fauna, particularly those that may be involved in the radiological exposure of man via the food chain route. A map that shows the distribution of the principal plant communities should be provided.

The discussion of species-environment relationships should include descriptions of area usage (e.g., habitat, breeding, etc.); it should include life histories of important regional animals and aquatic organisms, their normal seasonal population fluctuations; and it should include identification of food chains and other interspecies relationships, particularly when these are contributory to predictions or evaluations of the impact of planned activities on the regional biota.

Identify any definable preexisting environmental stresses from sources such as pollutants, as well as any ecological conditions suggestive of such stresses. Describe the status of ecological succession. Discuss the histories of any infestations, epidemics, or catastrophes (caused by natural phenomena) that have had a significant impact on regional biota.

The sources of information should be identified. As part of this identification, present a list of any published material dealing with the ecology of the region. Locate and describe any ecological or biological studies of the site or its environs now in progress.

2.9 Background Radiological Characteristics

Regional radiological data, including both natural background radiation levels and results of measurements of any concentrations of radioactive materials occurring in important biota, in soil and rocks, and in regional surface and local ground waters should be reported. This data, whether determined during the applicant's preoperational surveillance program (see Section 6.1.5) or obtained from other sources, should be referenced.

2.10 Other Environmental Features

For certain sites, some relevant information on the mill environs may not clearly fall within the scope of the preceding topics. Additional information may be required with respect to some environmental features in order to reflect the value of the site and site environs to important segments of the population. Such information should be included here.

3.0 THE MILL AND MINE

The operating mill and mine are to be described in this section. Since the environmental effects are of primary concern for this report, the mill and mine effluents and related systems that interact with the environment should be described in particular detail.

3.1 External Appearance of Mill

The building layout and plant perimeter, exclusion boundary, and plant profile should be shown to scale by line drawings or other illustrative techniques.

The architectural design and efforts to make the structures and grounds aesthetically pleasing should be noted.

3.2 Mill Circuit

The entire mill process and/or circuit should be quantitatively and qualitatively described in sufficient depth to permit confirmation of the quantities and constituents of all gaseous, liquid, and solid wastes and

effluents generated in the process. A flow diagram of the process and/or circuit should also be included.

3.3 Sources of Mill Wastes and Effluents

Clearly identify the location of release points for all gaseous, liquid, and solid wastes and effluents (including bulk storage locations, i.e., piles of ore and/or tailings, etc.) specifying quantities, concentrations, and the physical and chemical characteristics of all materials released. Average and maximum release rates should be included plus all pertinent supporting information such as assumptions and computational methods used. The quantities and concentrations of nonradioactive materials released into the environs should be compared with State and other applicable standards.

3.4 Controls of Mill Wastes and Effluents

Provide a description of mill waste and effluent control systems and equipment for minimizing to as low as practicable the quantities of materials released into the environment. Identify the operating efficiency factors for such systems and equipment in relation to current best methods for controlling milling wastes and effluents and describe the operating practices to be pursued during the life of the proposed mill.

For waste retention systems, a design analysis of the integrity of the proposed system(s) should be provided. This should include:

1. Drawings showing the layout in plan; typical cross sections of all embankments showing proposed design and, if applicable, anticipated future extensions; and other pertinent design details. Embankment design should include information on heights, top width, side slopes, freeboard, seepage control, and protection of embankment surfaces as well as foundation design.
2. The results of soil tests, geologic exploration, nature of foundation materials stability investigations, as well as characteristics of fill material and a description of the construction methods and specifications.

3.5 Sanitary and Other Mill Waste Systems

Describe any other nonradioactive solid or liquid waste materials, such as sanitary, laundry, and chemical laboratory wastes that may be generated during mill operation. Describe the manner in which they will be treated and controlled and describe procedures for disposal.

Describe any other gaseous effluents (i.e., from diesel engines, heating plants, incinerators) created during mill operation; estimate the frequency of release and describe how they will be treated before release to the environment.

3.6 Mining Activities

This portion of the report should contain a thorough description of the interrelated mining activities including:

1. Topographical maps showing locations and areas to be mined and haulage and access roads;
2. A description of the mining method(s) to be employed;
3. A description of the method(s) for accumulating and storing wastes in order to minimize aesthetic and other effects;
4. Identification of all sources of effluents associated with mining activities (haulage dusts, bulk storage locations, etc.), including release rates and concentrations and their physical and chemical characteristics;
5. A description of methods to minimize and control releases of effluents into the environs;
6. Any other information that might be helpful in assessing the environmental effects connected with the mining project.

4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, MILL CONSTRUCTION, AND MINE OPENING

The construction of a uranium mill and related mine opening will inevitably affect the environment; some of the effects will be adverse. Effects are considered adverse if environmental change or stress causes a valuable or otherwise important biotic population or natural resource to be less safe, less healthy, less abundant, less productive, less aesthetically or culturally pleasing; or if the change or stress reduces the diversity and variety of individual choice, the standard of living, or the extent of sharing of life's amenities; or if the change or stress tends to lower the quality of renewable resources or to impair the recycling of depletable resources.

In the applicant's discussion of adverse environmental effects, it should be made clear which of these are considered unavoidable and subject to later amelioration and which are regarded as unavoidable and irreversible. Those effects that represent an irretrievable commitment of resources should receive detailed consideration in Section 4.2. (In the context of this discussion, "irretrievable commitment of resources" alludes to natural sources and means a permanent impairment of these, e.g., loss of wildlife habitat; destruction of nesting, breeding, or nursing areas; interference with migratory routes; loss of valuable or aesthetically treasured natural areas; as well as expenditure of directly utilized resources.)

4.1 Site Preparation and Plant Construction

The applicant should organize the discussion in terms of the effects of site preparation (including mine opening) and mill construction on (a) land use and (b) water use. The applicant should consider consequences to both human and wildlife populations and indicate which are unavoidable, reversible, etc. according to the categorization set forth earlier in this section.

In the *land use* discussion, describe how construction activities may disturb the existing terrain

and wildlife habitats. Consider the effects of such activities as creating building material supply areas; building temporary or permanent roads, bridges, service lines; disposing of trash, excavating, and land filling. Provide information bearing on such questions as: How much land will be torn up? For how long? Will there be dust or smoke problems? What explosives will be used? Where and how often? Indicate proximity of human populations and identify undesirable impacts on their environment arising from noise, from inconvenience due to the movement of men, material, machines, including activities associated with any provision of housing, transportation, and educational facilities for workers and their families. Describe any expected changes in accessibility of historical and archaeological sites in the region. Discuss measures designed to mitigate or reverse undesirable effects, such as erosion control, dust stabilization, landscape restoration, control of truck traffic, and restoration of affected animal habitat.

The discussion should also include any effects of site preparation and mill construction activities whose consequences may be beneficial to the region.

The discussion of *water use* should describe the impact of site preparation and construction activities on area water sources. Such activities would include mine dewatering, diversion of streams, placement of fill material in the water, etc. The applicant should describe the effects of these activities on fish and wildlife resources, water quality, water supply, aesthetics, and so on as applicable. Measures to mitigate undesirable effects, such as pollution control and other procedures for habitat improvement, should be described.

4.2 Resources Committed

Discuss any irreversible and irretrievable commitments of resources (loss of land, destruction of biota, etc.) that are expected should site preparation and mill construction proceed. Such losses should be evaluated in terms of their relative and long-term net, as well as absolute, impacts. (See Section 5.6 of this guide for more detailed consideration.)

5.0 ENVIRONMENTAL EFFECTS OF MILL AND MINE OPERATION

This section describes the interaction of the mill and mine (discussed in Section 3) and the environment (discussed in Section 2). To the extent possible, material presented in Sections 2 and 3 does not need to be repeated. Measures planned to reduce any undesirable effects of the total project on the environment should be described in detail.

In the discussion of environmental effects, as in Section 4, effects that are considered unavoidable but either inherently temporary or subject to later amelioration should be clearly distinguished from those regarded as unavoidable and irreversible. Those effects that represent an irretrievable commitment of resources should receive detailed consideration in Section 5.6.

The impacts of operation of the proposed activity should be, to the fullest extent practicable, quantified and systematically presented. In the discussion of each impact, the applicant should make clear whether the supporting evidence is based on theoretical, laboratory, on-site, or field studies undertaken on this or on previous occasions. The source of each impact—the plant subsystem, waste effluent—and the population or resource affected should be made clear in each case. The impacts should be distinguished in terms of their effects on surface water bodies, groundwater, air, land, land use, ecological systems, and important plants and animals.

Finally, the applicant should discuss the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. The applicant should assess the action for cumulative and projected long-term effects from the point of view that each generation is trustee of the environment for each succeeding generation.

5.1 Radiological Impact on Biota Other Than Man

In this section the applicant should consider the impact on biota other than man attributable to the release of radioactive materials from the facility. The biota to be considered are those species of local flora and local and migratory fauna defined as "important" in Section 2.8. Since the region may contain many important species, the applicant need consider only those important species whose terrestrial and/or aquatic habitats provide the highest potential for radiation exposure.

5.1.1 Exposure Pathways

The various possible pathways for radiation exposure of the important local flora and local and migratory fauna should be identified and described in textual and flow-chart format. The pathways should include the important routes of radionuclide translocation (including food chains leading to important species) to organisms or sites.

5.1.2 Radioactivity in Environment

In Sections 3.3 and 3.6, the radionuclide concentrations in the liquid and gaseous effluents from the proposed activities are listed. In this section, the applicant should consider how these effluents are quantitatively distributed in the environment. Specifically, estimates should be provided for the radionuclide concentrations in any water sources, on land areas, and on vegetation (on a per unit area basis) in the environs. If there are other components of the physical environment that may become contaminated and thus cause the exposure of living organisms to radiation, they should be identified and their radioactivity burden estimated. In addition, information concerning any cumulative buildup of radionuclides in the environment should be presented and discussed. A summary of data, assumptions, and models used in

determining radioactivity concentrations and burdens should be provided.

5.1.3 Dose Rate Estimates

From considerations of the exposure pathways and the distribution of radioactivity released into the environs, the applicant should estimate the maximum radionuclide concentrations that may be present in important local flora and local and migratory fauna. Values of bioaccumulation factors[1] used in preparing the estimates should be based on site-specific data if available; otherwise, values from the literature may be used. The applicant should tabulate and reference the values of bioaccumulation factors used in the calculations.

5.2 Radiological Impact on Man

In this section the applicant should consider the radiological effects of operations and transportation of radioactive materials on man. Estimates of the radiological impact on man via various exposure pathways should be provided.

5.2.1 Exposure Pathways

The various possible pathways for radiation exposure of man should be identified and described in textual and flowchart format.

5.2.2 Liquid Effluents

Estimate the expected annual average concentrations of radioactive nuclides (listed in Sections 3.3 and 3.6) in receiving water at locations where water is consumed or otherwise used by human beings or where it is inhabited by biota of significance to human food chains. Specify the dilution factors used in preparing the estimates and the locations where the dilution factors are applicable.

Determine the expected radionuclide concentrations in aquatic and terrestrial organisms significant to human food chains. Use the bioaccumulation factors given in Section 5.1.3 or supply others as necessary.

Using the above information and any other necessary supporting data, calculate the total body and significant organ doses (rem/year) to individuals in the population (discussed in Section 2.2) from all receiving-water-related exposure pathways, i.e., all sources of internal and external exposure (provide details and models of the calculation as an appendix).

5.2.3 Gaseous Effluents

From release rates of radioactive gases and meteorological data (Sections 3.3, 3.6, and 2.7), estimate total body and significant organ doses (rem/year) to: individuals exposed at the point of maximum ground-level concentrations off site; individuals exposed at the site boundary in the direction of the prevailing wind; individuals exposed at the site boundary nearest to the sources of emission; and individuals exposed at the nearest residence in the direction of prevailing wind. Assume annual average meteorological conditions. Identify locations of points of release (stack, roof vent, etc.) used in calculations.

Estimate deposition of radioactive materials on food crops and pasture grass. Estimate total body doses (rem/year) and significant doses received by other organs via such potential pathways.

Provide an appendix describing the models used in these calculations.

5.2.4 Exposure Pathways

Provide estimates of individual total doses (rem/year) and population (discussed in Section 2.2) total doses (man-rem/year) that could be received via all pathways. Discuss any exposure pathways, if they exist, involving radionuclides accumulated in sediments or in other components of the environment.

5.2.5 Summary of Annual Radiation Doses

The applicant should present a table that summarizes the estimated radiation dose to the regional population from mill- or mine-related sources using values calculated in previous sections. The tabulation should include (a) the total doses (man-rem/year) to the population (discussed in Section 2.2) from all receiving-water-related pathways and (b) the total doses (man-rem/year) to the population attributable to gaseous effluents.

5.3 Effects of Chemical Discharges

In this section, the specific concentrations of nonradioactive wastes in effluents at the points of discharge should be compared with natural ambient concentrations without the discharge and also compared with applicable standards. The projected effects of the effluents for both acute and chronic exposure of the biota (including any long-term buildup in soils and sediments and in the biota) should be identified and discussed. Dilution and mixing of discharges into the receiving environs should be discussed in detail, and estimates of concentrations at various distances from the point of discharge should be provided. The effects on terrestrial and aquatic environments from chemical wastes that contaminate groundwater should be included.

5.4 Effects of Sanitary and Other Waste Discharges

Describe and discuss the environmental impact associated with sanitary and other mill waste systems discussed in Section 3.5.

5.5 Other Effects

The applicant should discuss any effects of plant operation that do not clearly fall under any single topic of Sections 5.1 to 5.4. These may include changes in land and water use at the plant site, interaction of the plant with other neighboring plants, and disposal of solid and liquid wastes other than those discussed in Sections 5.3 through 5.5.

5.6 Resources Committed

Discuss any irreversible and irretrievable commitments of resources due to mill operation and continued mining activities. This discussion should include both direct commitments, such as depletion of uranium resources, and irreversible environmental losses, such as destruction of wildlife habitat.

In this discussion, the applicant should consider lost resources from the viewpoints of both relative impacts and long-term net effects. As an example of relative impact assessment, the loss of a few animals of a given species could represent quite different degrees of significance, depending on the total population in the immediate region. Such a loss, however, in the case of a small local population, could be less serious if the same species were abundant in neighboring regions. Similarly, the loss of a given area of highly desirable land should be evaluated in terms of the total amount of such land in the environs. These relative assessments should accordingly include statements expressed in percentage terms in which the amount of expected resource loss is related to the total resource in the immediate region and in which the total in the immediate region is related to that in surrounding regions. The latter should be specified in terms of areas and distances from the site.

6.0 EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

The purposes of this section are to describe in detail the means by which the applicant collected the baseline data presented in other sections and to describe the applicant's plans and programs for monitoring the impacts of his proposed activities on the environment.

Section 6.1 is addressed to the measurement of preexisting characteristics of the site and the surrounding region. This program will establish a reference framework for assessing subsequent environmental effects attributable to the activity. The applicant's attention is directed to two considerations pertinent to this section. First, the term "preexisting" refers to the characteristics of the site prior to any mining-related activities. A given characteristic or parameter may or may not require assessment prior to site disturbance and mill construction, depending on whether that particular characteristic may be altered at these stages. Second, in most instances this guide indicates the specific environmental effects to be evaluated; consequently, the parameters to be measured will be apparent. In some cases, it may be necessary for the applicant to establish a monitoring program based on his own identification of potential or possible effects and to provide his underlying rationale for such. Accordingly, the applicant should carefully review the plans for measurement of preexisting conditions to ensure that these plans include all factors that must be subsequently monitored, as discussed in Section 6.2.

Sampling design, frequency, methodology (including calibration and checks with standards), and instrumentation for both collection and analysis should be discussed as applicable.

6.1 Applicant's Preoperational Environmental Programs

The programs for collection of environmental data prior to operation should be described in sufficient detail to make it clear that the applicant has established a thorough and comprehensive approach to environmental assessment. The description of these programs should be confined principally to technical descriptions of instrumentation, scheduling, technique, and procedures. Organizational aspects such as scheduling or validation are relevant only as they may bear upon technical program characteristics.

Where information from the literature has been used by the applicant, it should be concisely summarized and documented by reference to original data sources. Where the availability of original sources that support important conclusions is limited, the applicant should provide either extensive quotations or references to accessible secondary sources.[2] In all cases, information derived from published results should be clearly distinguished from information derived from the applicant's field measurements.

6.1.1 Surface Waters

When a body of surface water may be affected by the proposed activities, the applicant should describe the programs by which the background condition of the water and the related ecology were determined. In cases where a natural water body has already been subjected to environmental stress from pollutant sources, the nature of this stress and its consequences should be evaluated. The applicant should then estimate the potential quality of the affected water body.

6.1.2 Groundwater

In those cases in which the proposed activities may potentially affect local groundwater, the program leading to assessment of potential effects should be described.

6.1.2.1 Physical and Chemical Parameters

The properties and configuration of the local aquifer will have been defined in sufficient detail (in

Section 2.6) to permit a reasonable projection of effects of proposed activities on the groundwater. Methods for obtaining information on groundwater levels and groundwater quality should be described.

6.1.2.2 Models

Models may be used to predict effects such as changes in groundwater levels, dispersion of contaminants, and eventual transport through aquifers to surface water bodies. The models should be described and supporting evidence for their reliability and validity presented.

6.1.3 Air

The applicant should describe the program for obtaining information on local air quality, if relevant, and local meteorology. The description should show the basis for predicting such effects as the dispersion of gaseous effluents as well as present the methodology for gathering baseline data.

6.1.3.1 Meteorology

The applicant should identify sources of meteorological data relevant to such effects as the dispersion of gaseous effluents. Locations of observation stations, instrumentation, and frequency and duration of measurements should be specified both for the applicant's measuring activities and for activities of governmental agencies or other organizations on whose information the applicant intends to rely.

6.1.3.2 Models

Any models used by the applicant either to derive estimates of basic meteorological information or to estimate the effects of effluent systems should be described and their validity and accuracy discussed.

6.1.4 Land

Data collection programs concerning the terrestrial environment of the proposed facility should be described and justified with regard to both scope and methodology.

6.1.4.1 Geology and Soils

Geological studies conducted in support of safety analyses should be briefly summarized and reference made to the relevant safety reports for a more detailed presentation. The applicant should describe the collection of data on any soil conditions that may be altered by planned operations. The description should include identification of the sampling pattern and the justification for its selection, the sampling method, holding periods and preanalysis treatment, and analytic techniques.

6.1.4.2 Land Use and Demographic Surveys

The applicant should describe his program for identifying the actual land use in the site environs and for acquiring demographic data for the region.

Sources of information should be identified and their accuracy assessed. Methods used to forecast from data should be described.

6.1.4.3 Ecological Parameters

In this section the applicant should discuss the program used to assess the ecological characteristics of the site with primary reference to important terrestrial biota.

6.1.5 Radiological Surveys

This section of the Environmental Report should discuss the methods used to determine the preoperational radiation levels at the site and environs and the concentrations of any radioactive materials occurring in important local and regional biota, as well as in required soil, rocks, and surface waters.

The methods used should be thoroughly described and documented. The discussion should include identification of sampling or collection sites, sampling methods, duration and frequency, and analytical procedures (including preanalysis treatment, instrumentation, and minimum sensitivities) as applicable.

6.2 Applicant's Proposed Operational Monitoring Programs

The applicant should present the proposed operational monitoring program for planned operations. Review of this description will be facilitated if the applicant includes maps of observation sites and tabular presentation of summary descriptors of such factors as frequency, type of sampling, method of collection, analytic method, preanalysis treatment, instrumentation, and minimum sensitivities. The program description should be explicit with respect to the parameter limits that are not to be exceeded under normal operating conditions and with regard to the actions planned in the event the limits are exceeded.

6.2.1 Radiological Monitoring

The applicant's operational monitoring program for radiological effects should be described both for the mine and mill effluent-monitoring system and for the environmental monitoring program.

6.2.1.1 Mill Effluent--Monitoring System

Describe, in general, effluent-monitoring systems for radioactive liquid and gaseous effluents. Discuss the sensitivity limits for detecting radioactivity corresponding to routinely expected release rates. List the effluent streams, if any, that will not be monitored and provide a brief rationale for the absence of monitoring.

6.2.1.2 Environmental Radiological Monitoring

The operational surveillance program should be described in detail, with specific attention given to the types of samples to be collected, sampling locations and frequency, the analyses to be performed on each sample, and the criteria for investigating increases of concentration of material detected in the environs. The analytical sensitivity (detection threshold) for each analysis and the schedule for reporting data collected from the surveillance program should be discussed.

6.2.2 Chemical Effluent Monitoring

The proposed measurement program, including instrumentation, locations and frequencies, and analytical techniques, should be fully described. The description of the program should include instrumentation sensitivity and reliability. Monitoring procedures prescribed by local, State, or Federal agencies as conditions placed upon operation should be so identified.

The criteria for setting threshold levels for corrective action should be presented. In the case of prescribed quantitative standards set by agencies, the applicable regulation should be cited. In the case of quantitative limits set by the applicant to conform to qualitative standards or restrictions, the applicant's rationale should be presented. In either case, the action to be taken if measurements exceed thresholds should be specified.

6.2.3 Meteorological Monitoring

The applicant's program for monitoring meteorological phenomena should be described.

6.2.4 Ecological Monitoring

In the preoperational surveillance program the applicant will have established methodology for determining the ecological characteristics of the region. In principle, this methodology should be appropriate for the subsequent monitoring program to be maintained during plant operation. However, the applicant may choose to modify some aspects of his methodology in view of the requirement for protracted monitoring. Such aspects may include frequency, observation sites, and so forth. These should be described and justified. Also, the applicant should, in this section, indicate, to the extent feasible, how changes in the physiological and behavioral characteristics of the observed biota will be ascribed to specific effects of plant operation, to natural variation, or to other causes.

6.3 Related Environmental Measurement and Monitoring Programs

When the applicant's site lies within a region for which environmental measurement and/or monitoring programs are carried out by public or other agencies not directly supported by the applicant, these programs should be identified and discussed. Relevance of such independent findings to the proposed facility should be described, and plans for exchange of information should be presented. Agencies responsible for the programs should be identified, and to the extent possible, the procedures and methodologies employed should be briefly described.

7.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS

The applicant should discuss the environmental effects of possible accidents that may occur within the mill or during transportation of radioactive materials, whether or not these accidents might produce a radiological impact on the site and/or its environs.

7.1 Mill Accidents

The applicant should provide an operating accident analysis for a spectrum of accidents which might occur ranging in severity from trivial to very serious. Each class within the spectrum should be characterized by an occurrence rate or probability and their potential environmental consequences, if any. Examples of serious accidents would be a fire and/or explosion in a solvent extraction circuit or the failure of a waste retention system resulting from an act of nature or misoperation. Examples of intermediate accidents would be a failure of the air cleaning system serving the yellowcake area during operation, the rupture of a vessel containing mill solutions, or a failure of a waste distribution pipeline. An example of a trivial accident would be the malfunction of mill process equipment.

7.2 Transportation Accidents

The potential environmental effects from a transportation accident involving radioactive materials should be evaluated. Even though the probability of such an accident may be low and its consequences small, the applicant should identify the environmental effects that might result. Adequate documentation should be presented to provide assurance that all safety requirements will be met prior to transportation of radioactive materials.

7.3 Other Accidents

In addition to accidents that can release radioactivity to the environs, there may be accidents that, although radioactive materials are not involved, do have consequences that affect the environment. Such accidents as chemical explosions or fires, steam boiler failures, and leakage or rupture of vessels containing toxic materials can have significant environmental impacts. These possible accidents and associated effects should be identified and evaluated.

8.0 ECONOMIC AND SOCIAL EFFECTS OF MILL CONSTRUCTION AND OPERATION

The purpose of this section is to provide guidance on the information needed to assess the economic and social effects of the proposed facility.

There are, of course, limitations on the extent to which all the social and economic benefits and costs of a uranium milling project can be evaluated. The wide variety of benefits and costs are not only difficult to assess, but many are not amenable to quantification nor even to estimation in commensurable units. Some primary benefits such as the quantity of uranium recovered are, to a degree, measurable as are the capital costs and operating and maintenance costs of the proposed facility. On the other hand, numerous environmental costs and their economic and social consequences are not readily quantified.

8.1 Benefits

The primary benefits of the proposed nuclear facility are those inherent in the value of the uranium to be recovered and the kilowatt-hours of electricity which it represents.

There are other social and economic benefits which affect various political jurisdictions or interests to a greater or lesser degree. Some of these reflect transfer payments or other values which may partially, if not fully, compensate for certain services as well as external or environmental costs, and this fact should be reflected in the designation of the benefit. A list of examples follows:

- Tax revenues to be received by local, State and Federal governments.
- Temporary and permanent new jobs created and payroll (value-added concept).
- Incremental increase in regional product.
- Enhancement of recreational values.
- Environmental enhancement in support of the propagation or protection of wildlife and the improvement of wildlife habitats.
- Creation and improvement of local roads, waterways, or other transportation facilities.
- Increased knowledge of the environment as a consequence of ecological research and environmental monitoring activities associated with plant operation, and technological improvements from the applicant's research program.

The applicant should discuss significant benefits that may be realized from the construction and operation of the proposed mill. Where the benefits can be expressed in monetary terms, they should be discounted to present worth. In each instance where a particular benefit is discussed, the applicant should indicate, to the extent practical, who is likely to be affected and for how long. In the case of aesthetic impacts which are difficult to quantify, the applicant should provide pictorial drawings of structures or environmental modifications visible to the public (refer to Section 3.1).

8.2 Costs

The economic and social costs resulting from the proposed nuclear facility and its milling project are likewise complex and need to be appraised.

The primary internal costs are: (1) the capital costs of land acquisition and improvement; (2) the capital costs of facility construction; (3) other operating and maintenance costs including license fees and taxes; (4) plant decommissioning and tailings stablization costs; and (5) research and development costs associated with potential future improvements of the mill and its operation and maintenance. As in the case of benefits, the applicant should discount these costs to present worth.

There are also external costs. Their effects on the interests of people need to be examined. The applicant should supply, as applicable, an evaluation plus supporting data and rationale regarding such external social and economic costs. For each cost, the applicant should describe the probable number and location of the population group adversely affected, the estimated economic and social impact, and any special measures to be taken to alleviate the impact.

Examples of temporary external costs:

Shortages of housing; inflationary rentals or prices; congestion of local streets and highways; noise and temporary aesthetic disturbances; overloading of water supply and sewage treatment facilities; crowding of local schools, hospitals, or other public facilities; overtaxing of community services; the disruption of people's lives or the local community caused by acquisition of land for the proposed site.

Examples of long-term external costs:

Impairment of recreational values (e.g., reduced availability of desired species of wildlife and sport animals, restrictions of access to land or water areas preferred for recreational use); deterioration of aesthetic and scenic values; restrictions on access to areas of scenic, historic, or cultural interest; degradation of areas having historic, cultural, natural, or archaeological value; removal of land from present or contemplated alternative uses; reduction of regional product due to displacement of persons from the land proposed for the site; lost income from recreation or tourism that may be impaired by environmental disturbances; lost income attributable to environmental degradation; decrease in real estate values in areas adjacent to the proposed facility; increased costs to local governments for the services required by the permanently employed workers and their families. In discussing the costs the applicant should indicate to the extent practical, who is likely to be affected and for how long.

9.0 RECLAMATION AND RESTORATION

Discuss in depth plans for site reclamation and restoration including:

1. Plans for reclaiming and restoring lands disturbed by mining activities.
2. A technical and financial feasibility assessment on methods and costs of stabilizing tailings retention system(s).
3. Financial arrangements to be made (such as bonding arrangements, etc.) to insure that adequate funds will be available for site reclamation and restoration when operations are concluded.
4. Provisions for acquiring ownership of the property (if not already owned) on which the tailings will be stored.
5. Plans and methods for providing long-term maintenance and control over the tailings upon termination of milling activities.

10.0 ALTERNATIVES TO THE PROPOSED ACTION

In this section of the Environmental Report, the applicant's choice of a particular mill at a particular site must be supported through a comparative evaluation of available alternatives. The AEC will consider available alternatives that may reduce or avoid adverse environmental effects expected to result from construction and operation of the proposed milling and mining project. The AEC will not specify in advance which alternatives should be selected by the applicant for consideration; rather, the applicant should make this selection and also make clear the basis and rationale for the choices in regard to number, availability, suitability, and factors limiting the range of alternatives that might avoid some or all of the environmental effects previously identified.

11.0 BENEFIT-COST ANALYSIS

In this section the applicant's benefit-cost statement will be presented. The presentation should be made in the form of a narrative with accompanying tables and charts. The presentation should make clear what the applicant considers to be the important benefits and costs of the proposed facility and why, in the judgment of the applicant, the former outweigh the latter.

The applicant will have to develop criteria for assessing and comparing benefits and costs where these are expressed in non-monetary or qualitative terms. The rationales for the selection among site-mill alternatives, as well as among subsystem alternatives, should be presented. In any case, the applicant should carefully describe any aggregation of effects and discuss in detail the trade-offs that were made in order to justify the proposed plant. If any of the benefits or costs are deleted from the applicant's analysis, the rationale for doing so should be explained. The applicant should key all the terms used in the benefit-cost analysis to the relevant sections of the Environmental Report.

12.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

List all licenses, permits, and other approvals of construction and operations required by Federal, State, local, and regional authorities for the protection of the environment. List those Federal and State approvals that have already been received, and indicate the status of matters regarding approvals yet to be obtained. For general background, submit similar information regarding approvals, licenses, and contacts with local authorities.

Discuss the status of efforts to obtain a water quality certification under Section 401 of the Federal Water Pollution Control Act, as amended. If not already obtained, indicate when certification is expected. If certification is not required, explain.

In view of the effects of the plant on the economic development of the region in which it is located, the applicant should also note the State, local, and regional planning authorities contacted or consulted. OMB Circular A-95 identifies the State, metropolitan, and regional clearinghouse. (A listing of applicable clearinghouses may be obtained from the AEC.)

Cite meetings held with environmental and other citizen groups with reference given to specific instances of the applicant's compliance with citizen group recommendations.

13.0 REFERENCES

The applicant should provide a bibliography of all sources used in preparation of the Environmental Report. References cited should be keyed to the specific sections and page numbers to which they apply.

[1] The bioaccumulation factor is the equilibrium ratio: (concentration in organism)/(concentration in water).

[2] Any reports of work (e.g., ecological surveys) supported by the applicant that are of significant value in assessing the environmental impact of the proposed action should be included as appendices or supplements to the Environmental Report, unless the reports are otherwise generally available.